BERRY HARVESTER

BACKGROUND INFORMATION

FIELD OF THE INVENTION

[0001] The invention relates to the field of harvesting berry harvesters. More particularly, the invention relates to a walk-behind harvester. More particularly yet, the invention relates to blueberry harvester for use in small-scale fields.

DESCRIPTION OF THE PRIOR ART

[0002] Blueberry harvesting has traditionally been done by handpickers or rakers who walk along a row and rake through the bushes. The work is tedious and back-breaking, particularly when harvesting wild blueberries, as the bushes are low to the ground and the picker works in a bent-over position. Handpickers, being paid by the box of berries picked, often leave berries hanging on the bush if they feel that the amount of berries is meager, and wander on to more lucrative areas, resulting in a loss to the landowner.

[0003] Many attempts have been made to construct a mechanical harvester to rake blueberry bushes in a manner that removes all or most of the berries, without damaging the bush. In addition to raking the berries from the bush, the harvester also has to transport the berries into a container. Other considerations for a mechanical harvester are that it have a motorized ground travel, be lightweight enough not create ruts in the ground, and be safe to operate.

[0004] The prior art discloses many walk-behind harvesting machines, designed primarily for harvesting cranberries. Because these harvesters must travel over sandy bog, good traction on sandy ground is a major concern. For that reason, they are heavy

and have drive rollers that extend across the width of the harvester and that roll right over the vines. The berry-harvesting head of these harvesters has a system of rotating rakes and a pruning mechanism. The rotating rakes lift the cranberry vines from the ground and collect the berries onto the rakes, and simultaneously, the pruning mechanism prunes the vines. The machines are heavy and cumbersome and require extensive adaptation if they are to be used in blueberry fields. Also, due to the density of cranberries on the vines, the harvesting head rotates at a speed that is too slow for efficient blueberry raking. A typical conventional cranberry harvester that has, in the past, been used in blueberry fields is the Darlington harvester as disclosed in **U.S. Patent 2,780,905 (1957)**. The Darlington harvester picks only about 100 – 150 boxes of blueberries in a day, not much more than a handpicker. It is not possible to adapt the speed of the head to blueberry raking conditions because the mechanical action controlling the rakes through a rotation of the head is complex, and increasing the speed results in serious damage to the harvesting head. Furthermore, the diameter of harvesting head of the Darlington machine is too small for effective blueberry raking. For example, as a result of the small diameter, when the rakes come down into the blueberry bush, they are below the top of the bush and, therefore, they miss the blueberries growing in the upper portion of the bush.

[0005] An additional disadvantage of the Darlington harvester is that it does not have a safety shut-off that effectively shuts off the harvester when the operator relinquishes control. The harvester is only switched off when the off switch is actuated. This presents a safety hazard to the operator and to others working nearby in the field, and a source of property damage to the owner of the blueberry fields, because it will continue on in ground travel even after the operator has completely let go of it. For safety reasons, it is critical that, when the operator relinquish control of the machine, it shut down immediately.

[0006] What is needed, therefore, is a walk-behind berry harvester that is lightweight and easily maneuverable. What is further needed is such a harvester that effectively removes berries from a bush and transports the berries to a container, without damaging the bush or the berries. What is yet further needed is such a harvester that is operable at speeds that are determined by the harvesting conditions of the bushes in a section of a field. What is still yet further needed is such a harvester that is safe to operate.

BRIEF SUMMARY OF THE INVENTION

[0007] For the reasons cited above, it is an object of the present invention to provide a berry harvester that is lightweight and easily maneuverable. It is a further object to provide such a harvester that effectively rakes berries from a bush and deposits the berries in a container provided on the harvester. It is a yet further object to provide such a harvester that is operable at various speeds, adaptable to the berry harvesting conditions in a particular field or area of the field. What is still yet further needed is such a harvester on which the ground travel will shut off automatically when the operator relinquishes control of the harvester.

[0008] The objects of the invention are achieved by providing a walk-behind berry harvester having a rotatable rake head, a conveyor, and a single drive means for controlling the travel speed of the harvester and the conveyor, the speed of rotation of the rake head. The harvester according to the invention is suitable for raking any type of berry that grows on a relatively low bush. The application that was initially envisioned for the harvester according to the invention was that of a blueberry harvester, and thus, reference is often made herein to blueberries. It should be understood, however, the term "blueberry" is representative of any type of berry that can be raked from a bush.

[0009] The berry harvester according to the invention is a walk-behind wheeled vehicle, with a rock guard extending from the forward end of the harvester, close to the ground, and a rake head mounted on the frame of the vehicle above the rock guard. A conveyor is mounted rearward of the rake head, and a container support rearward of the conveyor. The wheels, the conveyor, and the rake head are driven by a motor mounted on the frame of the harvester. Control devices that control the drive mechanisms for the wheels and rake head are mounted on a handle. The operator of the harvester can independently switch the ground travel and/or the rake head on or off. The drive for the conveyor is coupled with that of the rake head. Thus, when drive for the rake head is enabled, the conveyor is operating. The speed of rotation of the rake head is linked to the ground travel speed of the harvester, as is the speed of the conveyor. When in operation, the rake head rotates through the bushes and rakes up berries. The berries are flung from the rakes into a conveyor, which carries them away and drops them into a berry container that is provided beneath the upper edge of the conveyor. A mount for additional berry containers is provided on the frame, for easy access by the operator.

[0010] The heart of the invention is the rake head, which extends across the entire forward end of the harvester. The rake head comprises a rake-head shaft with flanges mounted at each end. A plurality of rakes or combs are mounted on the flanges and extend parallel to the rake-head shaft, evenly spaced on the flanges, equidistant from the rake-head shaft. Thus, as the rake head rotates, each individual rake travels through a circular path defined by its distance from the rake-head shaft. Each individual rake includes a rake bar that contains a row of teeth. Each rake is rotatably mounted on the rake head and the rotation of the rake is controlled so that it maintains a particular orientation throughout a complete rotation of the rake head. In the harvester according to the present invention, the orientation is a sloping downward angle, relative to the vertical, to facilitate discharge of the berries from the rake. As the harvester travels forward, the rotation direction of the forward edge of the rake head is in the direction of

travel and the rake at the forward edge is travelling through a downward arc around the forward edge of the rake head. As the rake head rotates, it brings that rake down into the blueberry bush from above and draws it through the bush, from the forward side of the bush, relative to the direction of travel of the harvester, to the rearward side, collecting raked berries on the rake. As the rake head continues to rotate, that rake reverses its direction of travel, now traveling throught an upward arc. The raked berries that are collected on the rake are then flung from the rake onto the conveyor, which transports them upward and drops them into a berry collection box. Ideally, the diameter of the rake head is large enough so that the individual rake, as it rotates through the highest point in the rotation cycle, comes down toward the bush and enters at the top of the bush.

[0011] The conveyor is an endless conveyor that travels upward away from a lower section of the rake head toward the rear of the harvester. The uppermost part of the conveyor extends rearward over a berry collection box that is supported on the frame beneath it. The conveyor collects the berries as they are flung from the individual rake and dumps them into the berry collection box as the particular section of conveyor passes the highest point of the conveyor and begins its downward travel.

[0012] A single drive means with a main drive shaft provides the power to drive the wheels of the harvester, the conveyor, the rake head and the individual rakes. Power is applied simultaneously or selectively to the wheels and/or the rake head and conveyor. It is sometimes desirable to selectively apply power to the conveyor when the harvester is at a standstill, for example, when berry raking is completed, but some berries are have not completed the travel into the berry collection box. For this reason, the single drive means allows the operator to selectively apply power to the conveyor and the rake head, but not to the wheels, and vice versa. Thus, it is possible to operate the rake head and conveyor when the harvestor is not traveling forward and also to drive the harvester forward without operating the conveyor.

[0013] This selective application of power is accomplished by a two-belt drive system, with both belts briven by the main drive shaft. The belt pulley for the drive wheels is mounted directly on the shaft; the belt pulley for the rake head and conveyor is mounted on a bushing. The drive wheel pulley and the bushing for the rake head spin idly on the shaft when the respective belt is not tightened. Power is applied to the respective belt by tightening the belt. The harvester is provided with operator handles for maneuvering the harvester. A lever is provided on each handle that controls a belt tightener. Thus, one handle has a lever for tightening the belt around the drive wheel pulley; the other handle a lever for tightening the belt around the rake head pulley. By gripping both handles and levers, drive is applied to both the drive wheels and the rake head and conveyor. By releasing one or the other lever, the corresponding belt is loosened and, depending on the particular setup, the corresponding pulley then spins idly about the main drive shaft (which is still being driven by the motor).

[0014] During normal operation, the rake head and the individual rakes rotate at a speed that is relative to the speed of the ground travel, that is, the head makes one complete rotation over a certain distance of ground travel. Thus, if the harvester is traveling forward at a rapid rate, the head and the rakes rotate at a correspondingly rapid rate. Similarly, if the harvester is traveling forward at a slow rate, the head and rakes rotate at a correspondingly slow rate. Control of the rate of rotation of the rake head and the rakes is provided by a suitable mechanical system, such as a planetary gear system or an analogous chain and sprocket assembly. A central gear or sprocket, referred to hereinafter as a rake-head gear, is mounted at one end of the central head shaft. A planetary gear or sprocket, referred to hereinafter as a rake drive means, is mounted at the end of each individual rake and chains or gears that mesh with the rake-head gear couple the individual rake with the central head shaft. A belt-pulley link is provided between the rake head and the conveyor. The rake-head drive means, as mentioned above, is a belt-pulley drive mounted on the main drive shaft and coupled with a pulley on the central head shaft. Assuming the rake-head drive belt is tightened,

as the main drive shaft rotates, the conveyor and the central head shaft, as well as the individual rakes, are in operation.

[0015] An additional useful feature of the apparatus according to the invention is a supplemental-box mount that is provided on the frame. The berry boxes used for collecting berries have a particular standardized contour on the bottom, which allows the boxes to be stacked. The supplemental-box mount is a support bar that is adapted to receive and securely support a berry box in a manner that does not interfere with operation of the harvester, yet provides convenient access to the operator. Several boxes are stackable on the supplemental-box mount. This allows the operator to fill a box and deposit it for pick-up, and to quickly replace it with an empty berry box so that raking can continue with a minimum of interruption. This is of advantage to harvester operators, because conventional harvesters do not allow them to carry along extra berry boxes and they normally have to return to some particular location at the perimeter of the field to deposit the filled berry box and pick up an empty box. This may be time-consuming if the harvester operator is in the middle of a large field when the berry box is full.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a perspective view of the apparatus according to the invention.

[0017] FIG. 2 is a perspective view of the rake head.

[0018] FIG. 3A is a perspective view of the rake head, illustrating its mounting on the frame and the system of power transfer to the rake head and the rakes.

[0019] FIG. 3B is a side view of the power-drive end of the rake head, illustrating the interconnected drive means for the center head shaft and the individual rakes.

[0020] FIG. 3C is a side view of the harvester, illustrating the transfer of power from the rake-head drive shaft to the rake head.

[0021] FIG. 4 is a perspective view of the harvester, ullustrating power transfer to the conveyor.

[0022] FIG. 5 is a schematic illustration of power transfer from the motor to the rake head and to the ground-travel wheels.

[0023] FIG. 6 is a perspective view of the harvester, from the rear, illustrating the belt-tensioner cables and actuators, the support area for the berry collection box, and the supplemental-box mount.

DETAILED DESCRIPTION OF THE INVENTION

[0024] FIG. 1 is a schematic illustration of the major components of a walk-behind berry harvester **100** according to the invention. A forward end of the harvester **100** is designated as **100A**, and a rearward end as **100B**. The berry harvester **100** comprises a rake head **20** and a conveyor system **40**, both of which are mounted on a frame **2**. The rake head **20** comprises one or more rakes **22**. The drive system will be discussed in detail below, but for now, understand that the harvester **100** is propelled forward on motor-driven drive wheels **4**. Also mounted on the frame **2** at the forward end **100A** beneath the rake head **20** is a rock guard **5**. Just above the upper edge of the rock guard **5** is a baffle **7** that curves rearward and upward toward a lower end **40B** of the conveyor **40**. Both the rock guard **5** and the baffle **7** have a curvature that corresponds to that of the outer perimeter **21** of the rake head **20**. Beneath the baffle **7** is a ground roller **6** that rolls along the ground surface **G**. A support area **8** for a berry collection box **B** is provided at the rearward end **100B** of the harvester **100** and a chute **9** is mounted between an upper end **40A** of the conveyor **40** and the berry collection box **B**. As the

harvester **100** travels across the ground **G** in berry harvesting mode, the rake head **20** rotates in the direction indicated by head rotation arrow **H**, scoops berries from the bushes and drops them onto the conveyor **40**, which carries them upward and drops them over the upper end **40A** of the conveyor so that they land in the berry collection box **B**. The rock guard **5** protects the rake head **20** from hitting rocks and the baffle **7** serves to collect stray berries that don't make it onto the conveyor **40** when they are initially dropped from the rake **22**. The stray berries are then picked up the by next following rake **22**.

[0025] **FIG. 2** is a perspective view of the rake head **20** ready for assembly onto the harvester **100**. The rake head **20** is bounded at each end by a head flange **28**. Extending between the two head flanges **28** are a center head shaft **30** and, in the embodiment shown, four rakes **22**, each rake **22** constructed of a rake bar **24** having a plurality of rake teeth **26**. Depending on the ideal speed with which the harvester **100** is setup to run, any number of rakes **22**, including one rake **22**, may be assembled on the rake head **20** for most efficient operation of the harvester **100**. **[We may want to expound more on this.]**

[0026] **FIGS. 3A – 3C** illustrate a rake-head drive **20A** means for driving the rake head **20** and the rake bars **22**. In these illustrations, the frame **2** is shown either not at all or only incompletely for purposes of illustration. The rake head **20** is mounted on the frame **2** by means of the center head shaft **30**. The rake-head drive means **20A** comprises gear and/or chain-and-sprocket assemblies to drive the rotation of the rake head **20** as well as control the orientation of the rakes **22**. In the embodiment shown, chain-and-sprocket assemblies are used, although it is understood that a system of gears or gears with chains may also be used. As shown in **FIG. 3A**, the center head shaft **30** and the rake bars **24** are mounted in the end flange **28**. The rake bars are differentiated now as **24A – 24D**. A double-track sprocket **32** is mounted on the end of the center head shaft **30** and two of the rake bars **24B** and **24D**, whereby the sprocket

assembled at the end of rake bar **24D** is not visible. A first rake-bar drive chain **34** is assembled on a first track of the double-track sprockets **32**. Single sprockets **33** are mounted on rake bars **22A** and **22C**. A second rake-bar drive chain **36A** is assembled on a second track of the double-track sprocket **32** on rake bar **24B** and on the single sprocket **33** at the end of rake bar **22C**. Similarly, a third rake-bar drive chain **36B** is assembled on the second track of the double-track sprocket **32** at the end of rake bar **24D** and on the single sprocket **33** of rake bar **24A**. **FIG. 3B** is a side view of the end flange **28**, showing the interconnected arrangement of the chains **34, 36A, 36B**.

[0027] **FIG. 3C** is a side view of the rake head **20**, mounted on the frame **2**, showing the power transmission from a rake-head drive shaft **12** to the rake-head drive means **20A**. As shown, a gear **38** is mounted on the end of the center head shaft **30** and a rake-head drive chain **39** is assembled on the gear **38** and a first rake-head sprocket or gear **37** mounted on the end of the rake-head drive shaft **12**. The rake-head drive shaft **12** will be discussed in greater detail below.

[0028] As mentioned earlier, the rake bar **24** is constructed to rotate about its longitudinal axis so as to maintain a constant sloping angle of the rake teeth **26**, regardless of the instantaneous circumferential location of the rake bar **24** in the rotational cycle of the rake head **20**. Ideally, if more than one rake **22** is mounted on the rake head **20**, the teeth on each rake **22** deflect from the vertical to the same degree and direction. This parallel orientation of the rake teeth **26** of the individual rakes **22** is best seen in **FIG. 3A**. As the center head shaft **30** is rotated by means of the rake-head drive chain **39** and the gear **38**, the rake bars **24** are each forced to rotate about their longitudinal axes by means of the interconnected arrangement of the rake-head drive means **20A** described above.

[0029] **FIG. 4** shows the conveyor **40** and a conveyor drive means **42** that controls the operation of the conveyor **40** and its operating speed. The conveyor **40**, a wide, flexible, ridged belt made of a rigid synthetic material, is mounted just rearward of the

rake head **20**. A conveyor-drive shaft **44** that is splined or toothed over at least a portion of it extends into the conveyor **40** at its upper end **40A**, meshes with a mating geometry of the inside of the upper end **40A**, and drives the conveyor **40** directly. The rake-head drive shaft **12**, as well as the rake head **20** and rakes **22** rotate in a forward direction, while the conveyor travels in a rearward direction. Thus, the direction of rotation of the conveyor-drive shaft **44** has to be opposite the direction of rotation of the rake-head drive shaft **12**. This is accomplished by running a conveyor-drive chain **45** around a direction-reversing sprocket assembly **48**, which includes a first sprocket **48A** and a second sprocket **48B**, and around the first rake-head gear **37**, as shown in **FIG. 4**. With the arrangement shown, the drive power to the rake head **20** and the conveyor **40** is provided by the rotation of the first rake-head gear **37**. Thus, the speed of the conveyor **40** is attuned to the rotational speed of the rake head **20**; the faster the rake head **20** rotates, the faster the conveyor **40** runs.

[0030] **FIG. 5** is a schematic illustration of the power take-off from the motor **M**. The motor **M** is mounted on a support attached to the frame **2**, neither of which is shown in this FIG. A power shaft **50** comes off the motor **M** and provides the force to drive the wheels **4**, the rake head **20**, and the conveyor **40**. In the embodiment shown, a first belt-and-pulley assembly **52** provides the power to the rake head **20** and the conveyor **40**, and a second belt-and-pulley assembly **54** provides power to the ground-travel drive wheels **4**. Mounted on the power shaft **50** are two driver pulleys **52A**, **54A**. A central drive shaft **64** extends across a substantial portion of the width of the berry harvester **100**, parallel to the power shaft **50**. Mounted on one end of the central drive shaft **64** is a first transfer pulley **52B**. A second transfer pulley **54B** is mounted on a second end **12B** of the rake head drive shaft **12**, which is mounted on the central drive shaft **64**. The transfer pulleys **52B**, **54B** are drivably linked to the driver pulleys **52A** and **54A** by corresponding pulley belts **52C, 54C**. With continued reference to **FIG. 5**, an axle **60** connects the two drives wheels **4**. The axle **60** runs parallel to the central drive shaft **64**. Mounted on the central drive shaft **64** is a first gear **62A**; mounted on the axle is a

second gear **62B**. A gear chain **62C** links the first and second gears **62A,62B** and selectively engages the second gear **62B**. When the second gear **62B** is engaged, power is transmitted to the drive wheels **4**.

[0031] When the motor **M** is turned on, the central drive shaft **64** rotates at a constant speed. **[Is this true? How is speed of the central drive shaft adjusted, for example, if the harvester is to increase or decrease speed?]** Tightening one or both of the pulley belts **52C, 54C** causes the corresponding transfer pulleys **52B**, **54B** to rotate. Each of the two driver pulleys **52A**, **54A** is drivable, independent of the other. Thus, it is possible to engage the first belt-and-pulley assembly **52**, *i.e.*, to operate the rake head **20** and the conveyor **40**, while leaving the second belt-and-pulley assembly **54** that engages the ground-travel drive wheels **4** disengaged. The opposite is also the case. It is possible to engage the ground-travel drive wheels **4**, so as to maneuver the harvester **100** across the ground surface, while leaving the rake head **20** and conveyor **40** disengaged.

[0032] **FIG. 6** is a perspective view of the berry harvester **100**, as seen from the rearward end **100B**. Extending upward from the frame **2** are handles **2H**. Mounted on one handle **2H** is a first belt tensioner mechanism **57** and on the other handle **2H** a second belt tensioner **67**. The first belt tensioner mechanism **57** serves to engage the first belt-and-pulley assembly **52** and the second belt tensioner mechanism **67** engages the second belt-and-pulley assembly **54**. The first belt tensioner mechanism **57** includes a first pulley cable **56** that is attached to the first belt-and-pulley assembly **52** and when the belt tensioner mechanism **57** is depressed, the belt **52C** is tightened on the belt-and-pulley assembly **52** and power is transmitted to the rake-head **20** and the conveyor **40**. The second belt-tensioner mechanism **67** includes a second pulley cable **66** that is attached to the second belt-and-pulley assembly **54** and, when depressed, the belt **54C** is tightened on the second belt-and-pulley assembly **54** and power is transmitted to the ground-travel drive wheels **4**. The first and second belt tensioner

mechanisms **57**,**67** are designed such that they are easy to use when the operator is handling the harvester **100**. By simply letting go of one or the other belt tensioner mechanism on the handle, the corresponding belt-and-pulley assembly is immediately disengaged, resulting in immediate stopping of the corresponding rake head and/or ground-travel drive wheels. Thus, to interrupt all operation of the harvester **100**, both the first and second belt-and-pulley assemblies **52,54** are immediately disengaged when the operator lets go of both handles **2H**. This is a strong safety feature, as it prevents operation of the harvester **100** without operator control.

[0033] Also shown in **FIG. 6** is the chute **9** that aids in guiding berries from the conveyor **40** into a berry collection box that is positionable on the support area **8**. In the embodiment shown, the support area **8** is constructed as a metal frame that holds the conventional berry collection box, which has a contoured bottom. Divider plates **8A** are provided in the support area **8** that jut into the contours on the bottom of the box. The support area **8** shown here is designed to firmly and securely hold the berry collection box yet not add any more weight than necessary to the harvester **100**. For that reason, it is constructed of metal tubing, although it is understood other designs and constructions of the support area **8** may well be suitable for holding a berry collection box and are included within the scope of the present invention. A supplemental-box mount **80** that is attached to the frame **2** of the harvester **100** is also shown in **FIG. 6**. Again, the supplemental-box mount **80** is designed to add as little weight as possible to the harvester **100** and other designs are possible. The particular embodiment of the supplemental-box mount **80** shown is a simple structure designed to fit into the contours on the bottom of the conventional berry collection box. The berry collection boxes are stackable upon each other, and any number of berry collection boxes is stackable on the box mount **80**. The box mount **80** provides a simple and convenient means for the operator of the berry harvester **100** to carry extra berry collection boxes while processing a field. This allows the operator to set aside a full berry collection box for later pick-up and quickly and easily replace it with a fresh box.

[0034] It is understood that the embodiments described herein are merely illustrative of the present invention. Variations in the construction of the harvester may be contemplated by one skilled in the art without limiting the intended scope of the invention herein disclosed and as defined by the following claims.